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Soil Quality

Recent Trends in Conservation Agriculture under Mediterranean Conditions

CIHEAM
Centre International de Hautes Études Agronomiques Méditerranéennes
International Centre for Advanced Mediterranean Agronomic Studies

Soil Quality

What is soil?

- ✓ **The unconsolidated mineral or organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants**

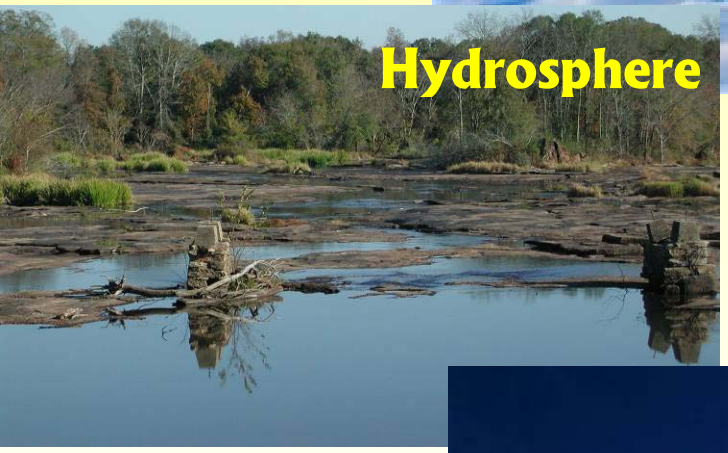
Soil Quality

Factors of soil formation

1. Parent material
   - Geological or organic precursors to the soil
2. Climate
   - Precipitation and temperature
3. Biota
   - Native vegetation, microbes, soil animals, humans
4. Topography
   - Slope, aspect, landscape position
5. Time
   - Elapsed time from exposure of parent material

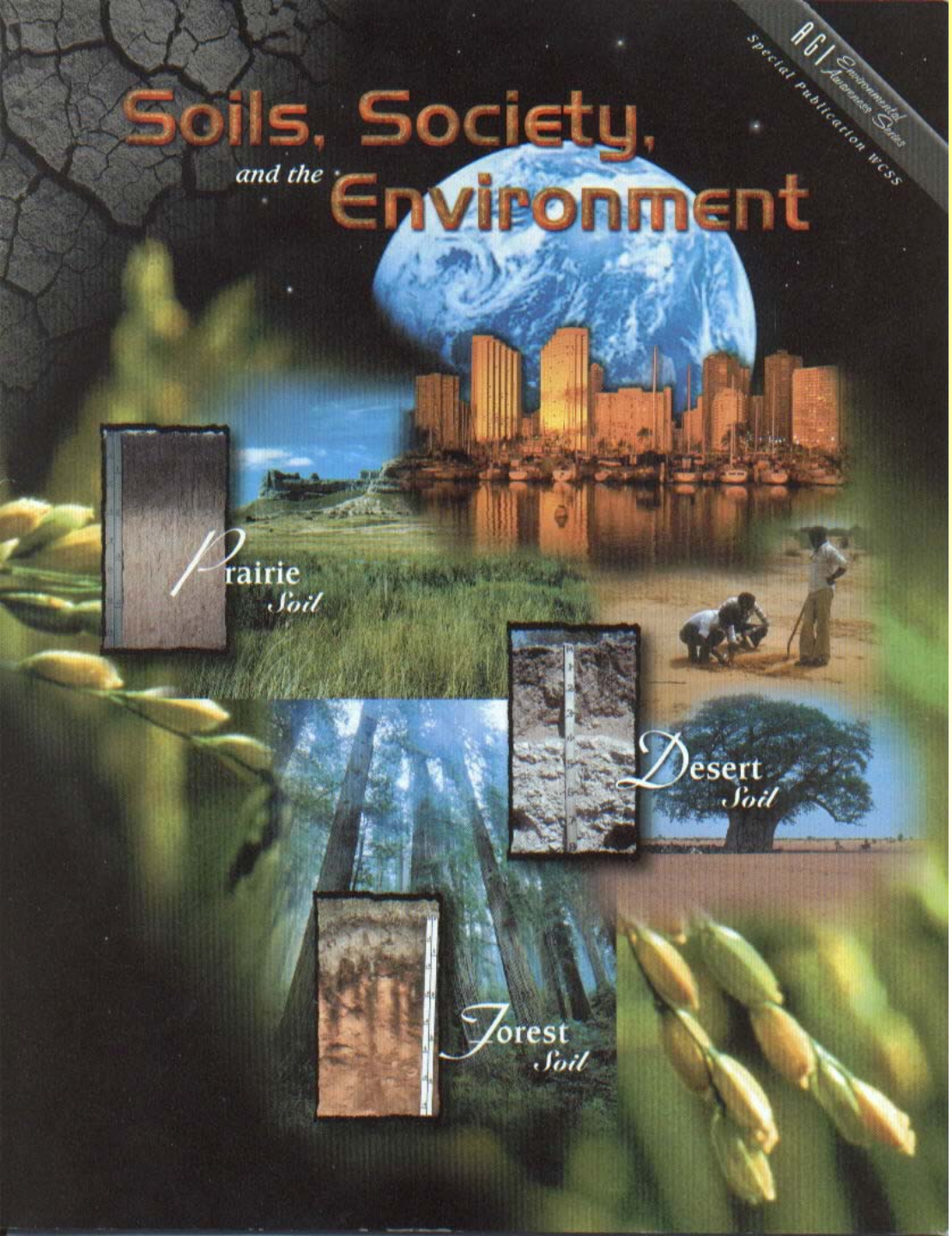
Soil Quality

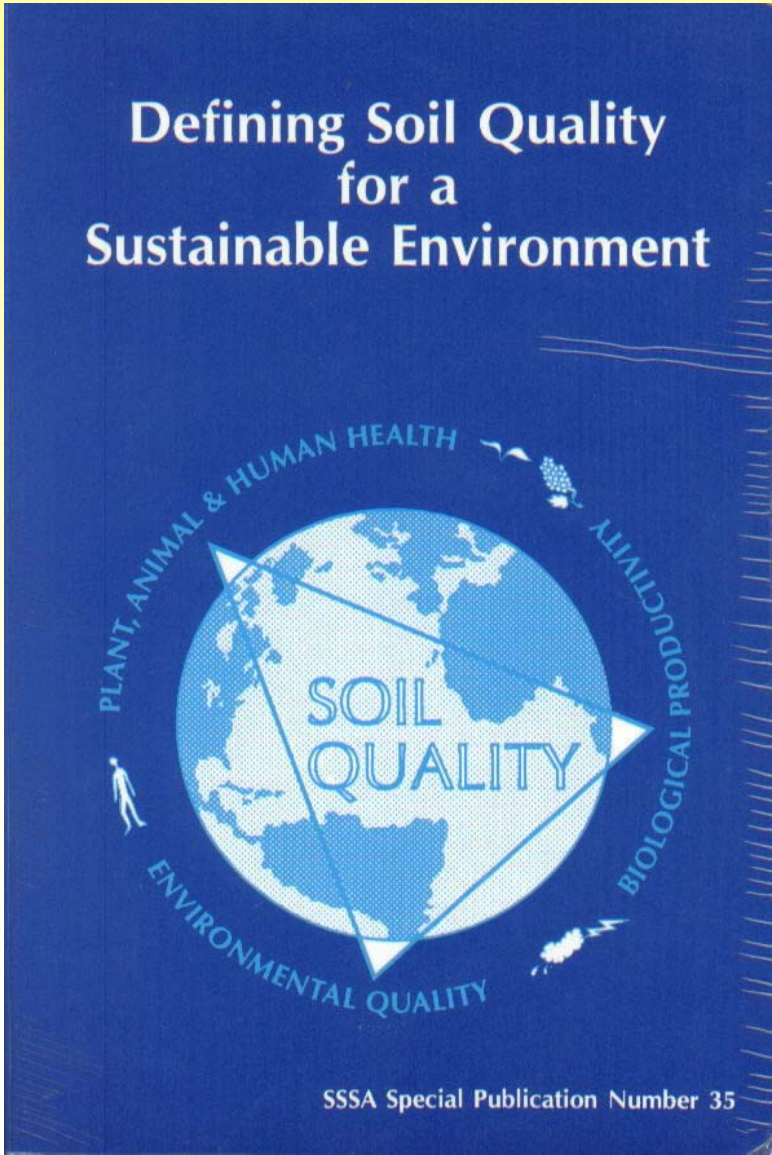
Relationships in the environment



SOIL

Soil Quality





Soil Quality

Why is soil important?

- ✓ **Soil is vital to all life on earth because it supports the growth of plants, which supply food and oxygen and absorb carbon dioxide and nitrogen.**

Soil Quality

Definitions

- ✓ **Capability of soil to produce safe and nutritious crops in a sustained manner over the long-term, and to enhance human and animal health, without impairing the natural resource base or harming the environment** (Parr et al. 1992; Am. J. Altern. Agric. 7, 5-11)

- ✓ **Capacity of soil to function within ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote plant and animal health** (Doran and Parkin 1994; SSSA Spec. Publ. 35)

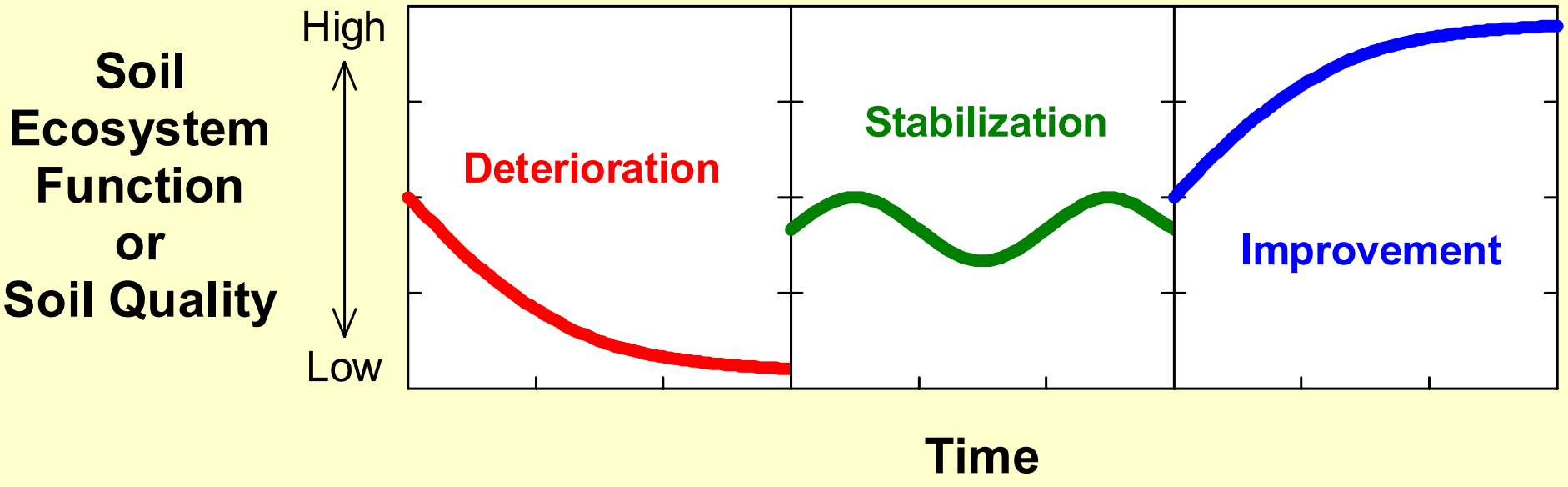
- ✓ **Capacity of soil to function** (Karlen et al. 1997; Soil Sci. Soc. Am. J. 61, 4-10)

- ✓ **How well soil does what we want it to do** (Schjønning et al. 2003; CABI Publ.)

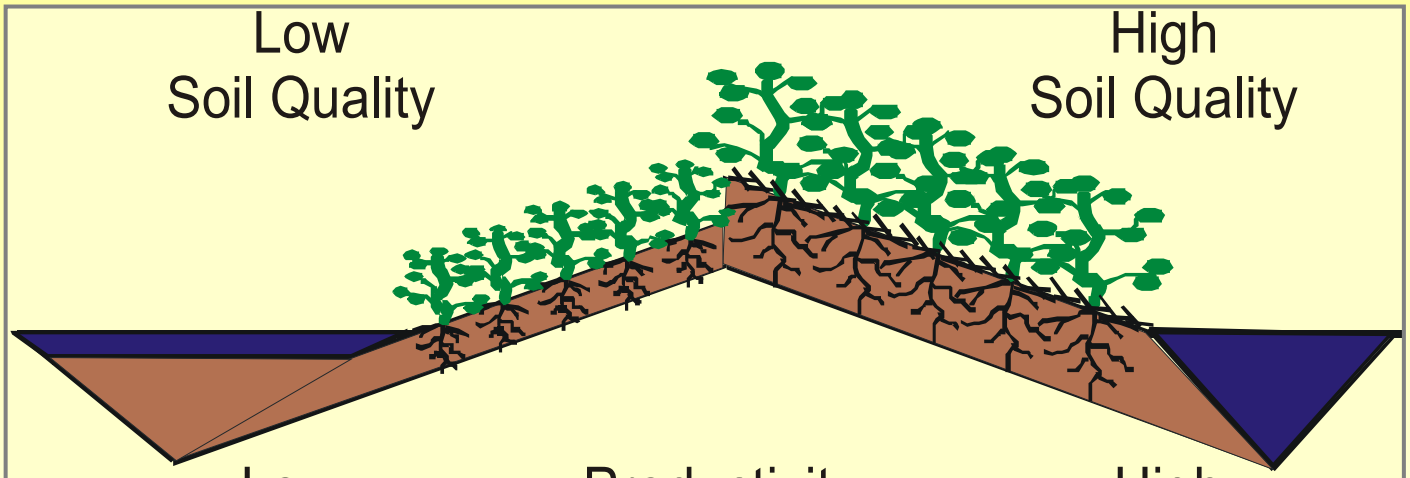
Soil Quality

Soil quality can

- ✓ **deteriorate** rapidly with poor management
- ✓ **stabilize** with time using adequate management, but undergo minor variations due to weather and crop conditions
- ✓ **improve** with time using best-available, adaptive techniques that restore key soil functions



Soil Quality

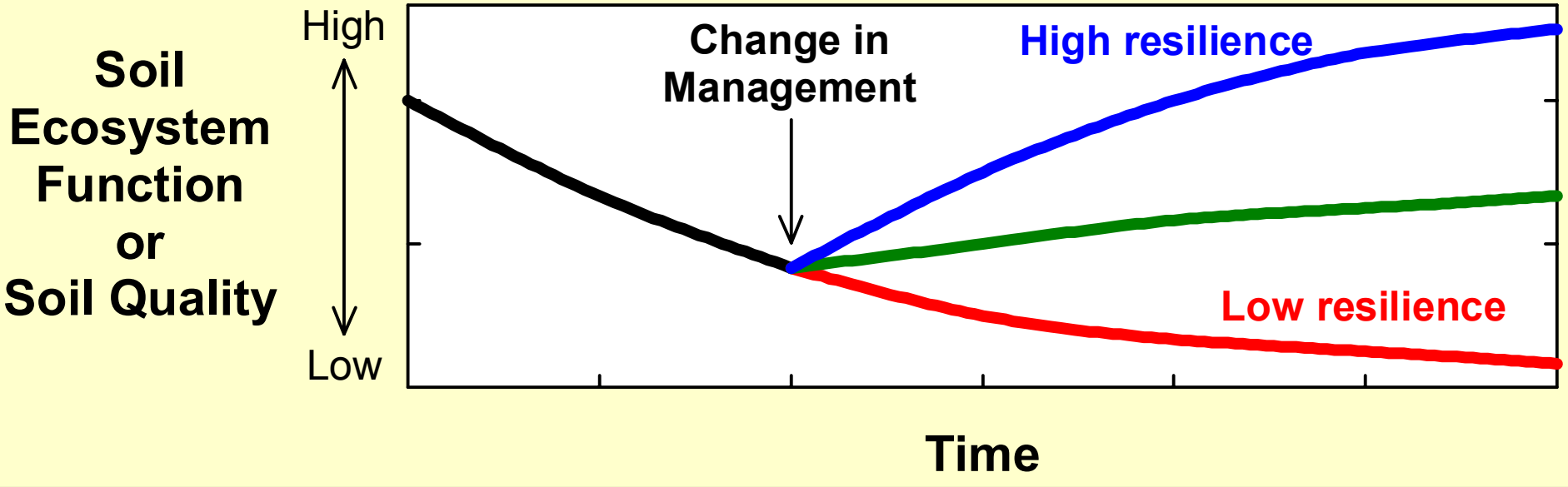


Low	Productivity	High
?	Healthy Food Supply	Yes
Low	Environmental Protection	High
Low	Land Stewardship	High
Low	Soil Organic Matter	High
High	Erosion / Sedimentation	Low
Low	Soil Microbial Activity	High
Low	Biological Diversity	High
Poor	Water Quality	Clean
Poor	Air Quality	Clean
?	Human Condition	Healthy

Soil Quality

Farmers making improvements to their operations will find that organic matter inputs, soil disturbance activities, and types and combinations of row cropping and sod-based management scenarios will have some of the largest effects on how soil functions.

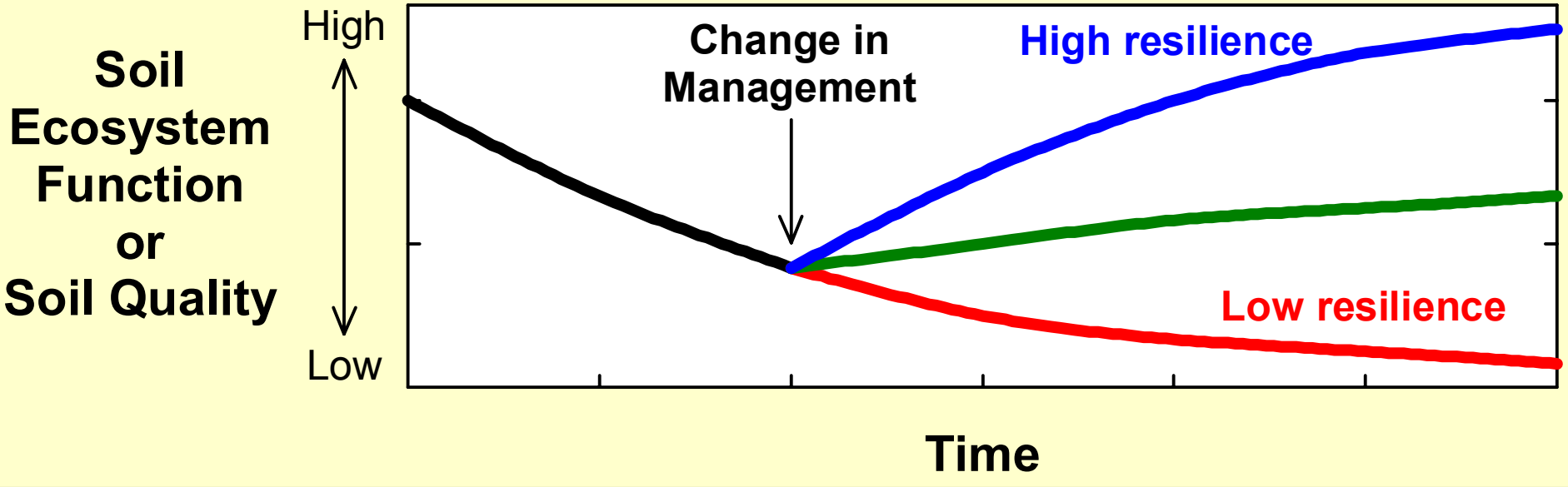
Some soils are resilient to poor management and others are not.



Soil Quality

Those soils that respond quickly to improved management practices (i.e. high resilience) will function in a sustainable manner relatively quickly and should be targeted for immediate restoration.

Those soils unresponsive to changes in management approach (i.e. low resilience) may need more intensive management inputs for an extended period of time to restore their functional capabilities within the landscape.



Soil Quality

Functions of soil

http://soilcrop.tamu.edu/research/sorghum/cornears.jpg

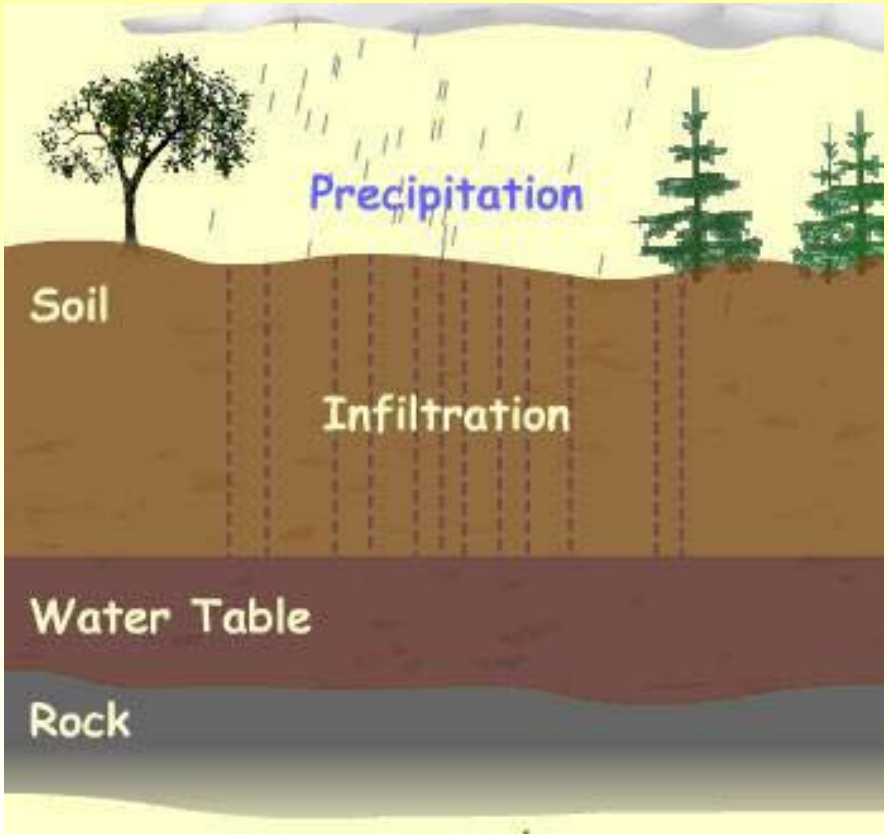
Medium for plant growth

http://www.organicagcentre.ca/assets/earthworm.jpg

Habitat for organisms

Soil Quality

Functions of soil



http://techalive.mtu.edu/meec/module06/images/Infiltration.jpg

http://www.grow.arizona.edu/SPTUI--CWIS/Themes/Theme--Grow/feature2.jpg

Engineering medium

System for water supply and purification

Soil Quality

Functions of soil

Recycling system for nutrients and organic waste

Soil Quality

Summary

Soil quality is directly linked to broad societal issues of

- ✓ food production
- ✓ food security
- ✓ environmental quality

through it effects on more tangible elements of

- ✓ energy use in food production
- ✓ global warming
- ✓ water quality

Soil Quality

Summary

Soil quality is the capacity of soil to function as a provider of key ecosystem services, such as

- ✓ supplying and cycling of nutrients for optimum plant growth
- ✓ receiving rainfall and storing water for root utilization
- ✓ filtering water passing through soil to support clean groundwater
- ✓ storing organic carbon for nutrient retention and mitigating greenhouse gas emission
- ✓ decomposing organic matter and xenobiotics to avoid exposures to plants and the environment

Soil Quality

Summary

Soil organic matter is a key attribute of soil quality, because it is a source of energy and substrate for microbial activity and diversity.

Surface residue is essential to control water runoff and erosion. Along with undisturbed soil, it contributes to surface soil organic carbon (C) accumulation and an increase in soil quality.

Surface soil organic carbon is a key ingredient that links water quality with soil quality through its influence on soil structure, water infiltration, and nutrient cycling.